SURVIVING THE ACID TEST: INITIAL PERFORMANCE OF A BALLOON FOR LONG DURATION STUDIES OF THE ATMOSPHERE OF VENUS

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After many years, Venus has again become a focus of interest for planetary science missions. Since April 11, the Venus Express spacecraft has been orbiting the planet, the first new orbiter to assess the Venusian atmosphere and climate in over 25 years. On a daily basis, Venus Express has been acquiring near-infrared views of the surface as well as three-dimensional measurements of winds, temperatures, and several important reactive species, to name just a few measurement goals of the mission. Yet such a remote sensing mission does not effectively address many high priority science objectives of the National Research Council Decadal Survey. For example, these missions are unable to measure noble gas abundances, key to understanding the origin and early evolution of the planet. Only *in-situ* missions can address such key goals by providing the requisite measurements of noble gases and their isotopes, and the isotopes of light elements. Long-lived balloon–borne missions provide additional powerful and unique capabilities to assess the planets dynamics, meteorology, and reactive chemistry at very fine scales. As one example, such missions can provide precise measurements of local variations in vertical motions and heat transport, thus providing new insights into the nature of (1) topographically-forced gravity waves, (2) large-scale planetary waves, and (3) convection.

In this paper we describe the approach, design and expected performance of a balloon capable of carrying a 40-50 kg instrumented gondola for extended duration, globe-encircling flights in the sulfuric cloud atmosphere of Venus near the 55-km level. We show the results of recent testing of both (1) our Venus balloon material and of (2) a full-scale, flying, balloon prototype. The results show that the material properties and balloon performance are close to the design predictions and more than fulfill mission design requirements. High material strength and low gas permeability ensure that such a balloon will be able to circumnavigate Venus several times at any latitude.